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SYNOPSIS

Title: **Study and Analysis of R-R Time Series Signal in Yoga**

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Introduction :

Stress is one of the biggest problems in our society and in health care. Stress costs billions of dollars a year in health care and incalculable costs in terms of human suffering. According to the American Psychological Association, three-quarters of all Americans experience symptoms related to stress in a given month, and half of Americans report lying awake at night due to stress. Workplace stress costs more than $300 billion each year in health care costs, missed work and stress reduction. Stress contributes to heart disease, hypertension, strokes and other diseases. When we are stressed, our bodies shift into “fight or flight” mode as the body prepares to confront danger or flee from it. Adrenaline and other hormones flood our bodies, accelerating heart and lung action. We may flush or pale, and begin sweating. Many processes such as digestion slow or cease. None of this is good for our bodies or minds over a prolonged period of time. But stress–while not entirely avoidable can be managed without resource to prescription medication. Any individual who wants to control stress can do so. Heart rate variability (HRV) is one of the ways stress can be monitored. By understanding HRV and monitoring it regularly, you can control and lower your stress levels. Stress poses a problem to everyone because it interrupts the smooth flow of energy through the body. When the body shifts into stress mode, it creates a block, which requires work and time to remove.

Yoga and Autonomic Influence

Yoga involves a diverse range of mind-body practices such as meditation/relaxation techniques (*dhyana*), breathpractices (pranayama), and physical postures (asana) that aim to integrate the mind and body and bestow the practitioner with physical, mental, intellectual, and spiritual development. Several studies report associations between yoga and markers of autonomic activity such as HR, baroreflex sensitivity, galvanic skin resistance, evoked potentials, attention, cognitive ability, emotional regulation, and mental resilience. Further studies report that regular yoga practice improves a wide range of clinical conditions associated with autonomic dysfunction, such as hypertension, diabetes, anxiety, depression, and pain. Furthermore, two systematic reviews report that yoga practices have profound effects on autonomic and metabolic activities and reduce cardiovascular risk.

In the online journal, EmpowHer, Mary Kyle has written an article on heart disease and the positive effects of Yoga. She writes, "Yoga practitioners exhibit an increase in flexibility, strength, and muscle tone," along with lower stress levels, improvement in blood pressure levels, lung capacity, heart rate, circulation, and respiratory function. Mary uses a 2009 study conducted at the Indian Instutitute of Technology in Roorkee, India, to show how this all relates to heart rate variability. The study shows that "HRV rates were higher in yoga practitioners even when no cardiac coniditon was present and had healthier hearts than non-yoga practitions."

Despite the known, strong relationship between autonomic function and HRV, and multiple reports of changes in HRV with yoga practice, the literature on yoga and HRV has not yet been subjected to a comprehensive review. Therefore, the proposed research work aims to review the existing literature and conduct further research to create relationship between HRV and Yoga.

Heart Rate Variability:

Over the last four decades, decreased in **heart rate variability** HRV has received increasing attention as a prognostic indicator of risk associated with a variety of chronic diseases, morbidity, mortality and aging . Nowadays the main stream of medical society accepts HRV as one of the best predictors of nonspecific health risk. Panin and Bajevski first proved that HRV reflects the stress provoked by cosmic flights. Latter Danev et all find a strong positive relationship between HRV decrease and mental effort in a series of laboratory well controlled experiments. Recently HRV is used for assessment of the harmful effect of a large class of stresses including environmental pollution, dietary problems, psychosocial discomfort or behavioral disorders. HRV was proved to reflect also the stage of development of many clinical diseases (f. ex. diabetes, hypertonia, thyreotoxicosis, leukemia, different kinds of carciomatosis etc. Due to these findings in the last few decades HRV becomes one of the best diagnostic tools of the modern medical practice. The practical employment of this method in environmental and occupational aspect needs special software and hardware facilities.

HRV is mirroring the regularity of hearth beats: bigger regularity - lowers HRV (and vices versa). Regularity of heartbeats is derived from a quantity of numbers; equal to the times elapsed between successive heartbeats. They are named cardiointervals (or R - R intervals) and are measured in ms. **Cardiointervals** are obtained from ECG as it is demonstrated on Fig. 1 below.

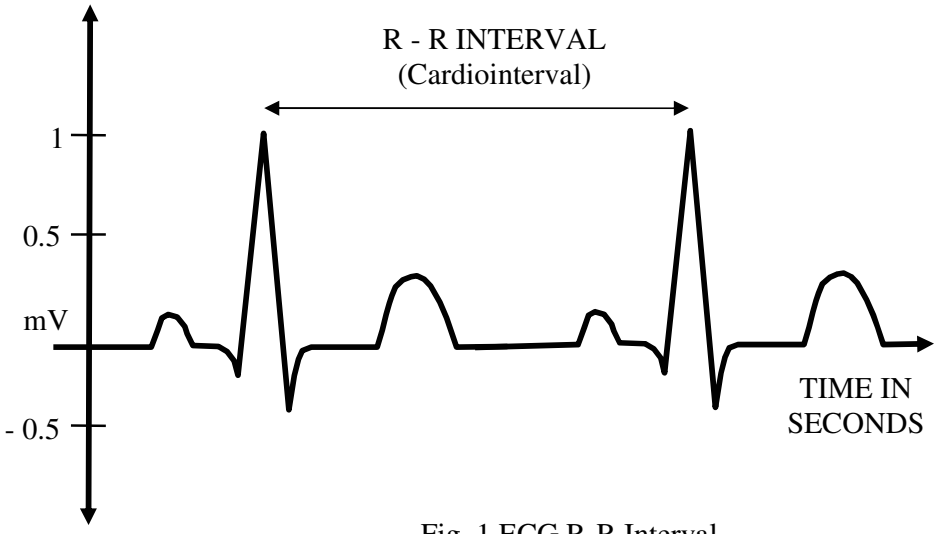

Fig. 1 ECG R-R Interval

HRV is modulated by the activity of both branches of the autonomic nervous system: sympathicus and parasympathicus (vagus). Generally, the increased sympathetic tone is connected with a diminution of the HRV, whereas the increased parasympathetic input increases HRV.

Objectives:

Beat-to-beat variations in heart rate i.e Heart Rate Variability, or HRV have recently been recognized as markers of autonomic function, cardiovascular health, outcomes associated with cardiovascular disease, and a sedentary lifestyle.

There has been limited study of HRV in Yoga. Therefore, the proposed research work aims to review the existing literature and conduct further research to create relationship between HRV and Yoga.

Therefore, the objectives of proposed research work are :

To develop a computerized heart rate variability detection system and protocol by means of which we can :

1. Noninvasively and reliably characterize and study normals and subjects with Yoga activity.
2. Compare the responses between these populations
3. Evaluate how Yoga improves HRV

Methodology:

A) Two groups will be studied:

1. Normal
2. Subjects with Yoga activity

Wireless system will be used to acquire Heart Rate data from the subjects. At a time about two minutes data will be acquired from the subject in three different modes:

1. Supine position
2. Standing position
3. Five seconds rhythm respiration

B) Low cost and reliable computerized wireless system will be developed for data- acquisition and signal processing. A block diagram of proposed system is shown in Fig.2 below.

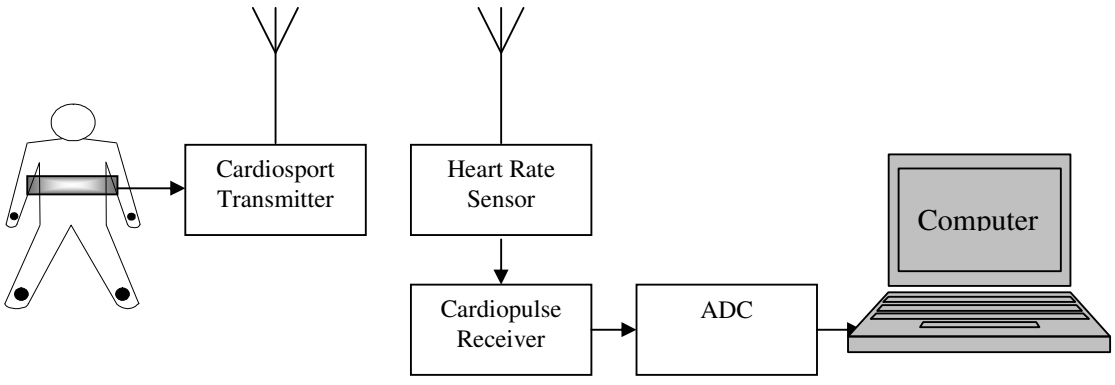

Fig. 2 Proposed System

Work Plan:

Duration : 1.5 Years.

Sr. No.	Phase	Period	Activity
1	I	6 Months	Development of hardware and software
2	II	6 Months	Data acquisition from subjects and statistical analysis
3	III	6 Months	Data evaluation and preparation of Thesis

References:

1. A.G. Patil, R.H.Chile, S.T. Hamde, *Assessment of Functional Efficiency of Autonomic Nervous System in SCI Subjects Using RR Variability,* International Journal of Bioscience, Biochemistry and Bioinformatics, IJBBB 2012, Vol. 2, No. 4, PP. 259-263, July 2012.
2. A.G. Patil, R.H.Chile, S.T. Hamde, *Model Based Analysis of Sympathetic and Parasympathetic Nervous Systems in Spinal Cord Injured Subjects Using RR Variability*, 2nd International Conference on Biomedical Engineering and Technology, 2-3 June, 2012, Hong Kong, IPCBEE vol. 34 (2012) © (2012) IACSIT Press, Singapore.
3. A.G. Patil, R.H.Chile, S.T. Hamde, *Statistical Analysis of RR Series Variability in Spinal Cord Injured Persons,* Journal of Medical Engineering & Technology, Informa Healthcare, April 2012, Vol. 36, No. 3 , Pages 180-184.
4. A.G. Patil, R.H.Chile, S.T. Hamde, *Wireless System for Measurements of RR Variability During Physical Activity*, The Internet Journal of Bioengineering, ISPUB, Volume 3 Number 2, 2008.
5. A.G. Patil, R.H.Chile, S.T. Hamde, *RR Variability in Spinal Cord Injured Patients,* Internet Journal of Bioengineering, ISPUB, Volume 3 Number 1, 2008.
6. A.G. Patil, R.H.Chile, S.T. Hamde, *Spinal Cord Injury Alters RR Variability: A Comparative Study Between Normal and Spinal Cord Injured Persons*, Proc. of the 3rd WACBE World Congress on Bioengineering 2007, ISBN: 978-81-904262-8-2 (RPS) © 2007 WACBE'07, Bangkok, Thailand, July 9-11, 2007.
7. A.A.Patil, A.G.Patil, *Wireless R-R Interval Data Acquisition and Analysis System for study of Heart Rate Variability*, Proc. of the 3rd WACBE World Congress on Bioengineering 2007, ISBN: 978-81-904262-8-2 (RPS) © 2007 WACBE'07, Bangkok, Thailand, July 9-11, 2007.
8. A.G. Patil, R.H.Chile, S.T. Hamde, *System for Study and Analysis of R – R Time Series Signal in Spinal Cord Injury Patients*, National Conference on Emerging Trends in Biomedical Engineering (BIOCON-2005), Bharati Vidyapeeth Deemed University, College of Engineering, Pune, September 15-16, 2005.
9. Danev S., H.Wartna, B.Bink, J.Lutein, J.Rader: (1971) Assessment of information load. Ned. Tjidshrift foor de Psychology XXI, 1.
10. `Analysis of heart rate variability', B. Mac. Sayers, Ergonomics 16, 17-32, 1973
11. `How reproducible is the power spectrum of heart rate variability in health subjects ?', E.L.Fallen, D. Nandagopal, S.Connolly and D.N. Ghista, Proceedings of International Symposium on Nerul and Cardiovascular mechanisms, May 1985, Geneva, Italy.
12. `Heart rate variability power spectrogram as a potential noninvasive signature of cardiac regulatory system response mechanisms, and disorders', M.V.Kamath, D.N.Ghista, E.L.Fallen, D.Fitchett, D.Miller and R.McKelvie, in Heart and Vessels, 3,33-41,1987.

13. `Methamatical modeling of the enteric nervous network - 4', Analysis of adrenergic transmission, R.N.Miftakhov and D.L.Wingate, Med. Eng. Phys. Vol.17, 3-10,1995
14. Heart Rate Variability and Physical Activity Level after Spinal Cord Injury, Jon N. Myers, PhD; K Gladysheva, BA; Heather E. Brown, MSPT; Inder Perkash, MD; B. Jenny Kiratli, PhD; VA Rehabilitation Research and Development Service, project #B2549-R.
15. Model-Based Analysis of Heart Rate and Blood Pressure Variability I. Korhonen, J.P. Saul, R. Takalo, V. Turjanmaa, *32 nd Scandinavian Congress of Neurology & 1 st Scandinavian Congress of Neurologic Nursin*g, Oulu, Finland, June 10-13, 1998
16. Kyle, Mary. "Heart Healthy Benefits of Yoga." EmpowHER.com. EmpowHER Media, 05 Feb. 2012. Web. 14 Feb. 2012. <http://www.empowher.com/heart-disease/content/heart-healthy-benefits-yoga>.
17. Innes KE, Bourguignon C, Taylor AG. Risk indices associated with the insulin resistance syndrome, cardiovascular disease, and possible protection with yoga: A systematic review. J Am Board Fam Pract 2005;18:491-519.
18. Bowman AJ, Clayton RH, Murray A, Reed JW, Subhan MM, Ford GA. Effects of aerobic exercise training and yoga on the baroreflex in healthy elderly persons. Eur J Clin Invest 1997;27:443-9.
19. Telles S, Raghavendra BR, Naveen KV, Manjunath NK, Kumar S, Subramanya P. Changes in autonomic variables following two meditative states described in yoga texts. J Altern Complement Med 2013;19:35-42.
20. Telles S, Singh N, Puthige R. Changes in P300 following alternate nostril yoga breathing and breath awareness. Biopsychosoc Med 2013;7:11
21. Telles S, Raghuraj P, Arankalle D, Naveen KV. Immediate effect of high-frequency yoga breathing on attention. Indian J Med Sci 2008;62:20-2.
22. Chaya MS, Nagendra H, Selvam S, Kurpad A, Srinivasan K. Effect of yoga on cognitive abilities in schoolchildren from a socioeconomically disadvantaged background: A randomized controlled study. J Altern Complement Med 2012;18:1161-7.
23. Cramer H, Lauche R, Langhorst J, Dobos G, Paul A. Quality of life and mental health in patients with chronic diseases who regularly practice yoga and those who do not: A case-control study. Evid Based Complement Alternat Med 2013;2013:702914
24. Tyagi A, Cohen M. Yoga and hypertension: A systematic review. Altern Ther Health Med 2014;20:32-59.
25. Hagins M, States R, Selfe T, Innes K. Effectiveness of yoga for hypertension: Systematic review and meta-analysis. Evid Based Complement Alternat Med 2013;2013:649836
26. Li AW, Goldsmith CA. The effects of yoga on anxiety and stress. Altern Med Rev 2012;17:21-35
27. Pilkington K, Kirkwood G, Rampes H, Richardson J. Yoga for depression: The research evidence. J Affect Disord 2005;89:13-24
28. McCall MC, Ward A, Roberts NW, Heneghan C. Overview of systematic reviews: Yoga as a therapeutic intervention for adults with acute and chronic health conditions. Evid Based Complement Alternat Med 2013;2013:945895
29. Tyagi A, Cohen M. Oxygen consumption changes with yoga practices: A systematic review. J Evid Based Complement Alternat Med 2013;18:290-308
30. Posadzki P, Kuzdzal A, Lee MS, Ernst E. Yoga for heart rate variability: A systematic review and meta-analysis of randomized clinical trials. Appl Psychophysiol Biofeedback 2015;40:239-49.